10/521697

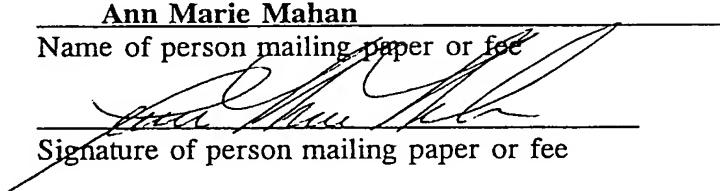|		
Applicants	:	MYKROLIS CORPORATION et al.
International Application No.	:	PCT/US03/22533
International Filing Date	:	18 July 2003
For	:	FLUID FLOW MEASURING AND PROPORTIONAL FLUID FLOW CONTROL DEVICE
Authorized Officer	:	Virginia Irby
Attorney Docket No.	:	200200030-PCT

Commissioner for Patents
P.O. Box 1450
Mail Stop: PCT
Alexandria, VA 22313-1450

Type of paper	:	**Formal Drawings (20-sheets)**

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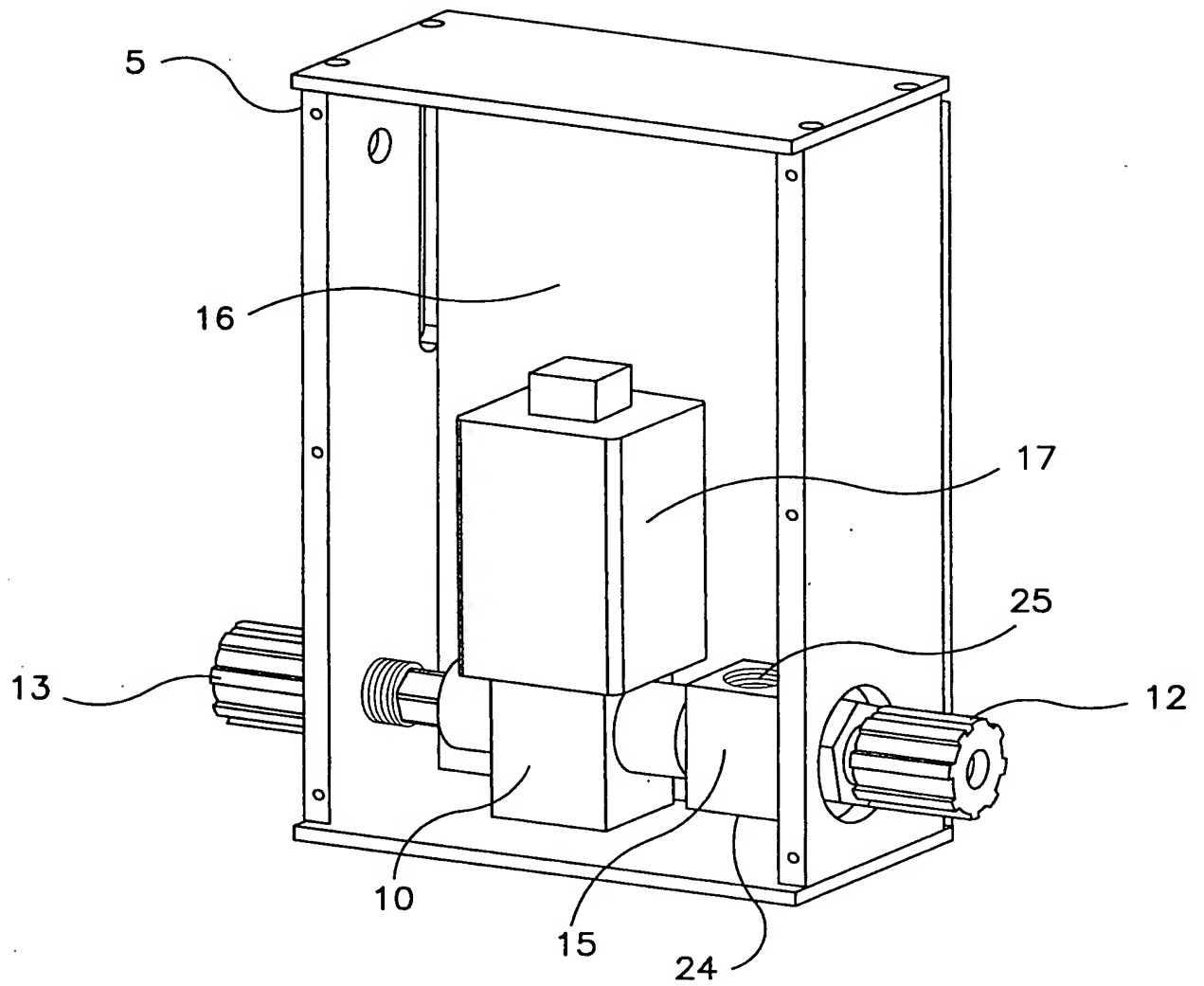
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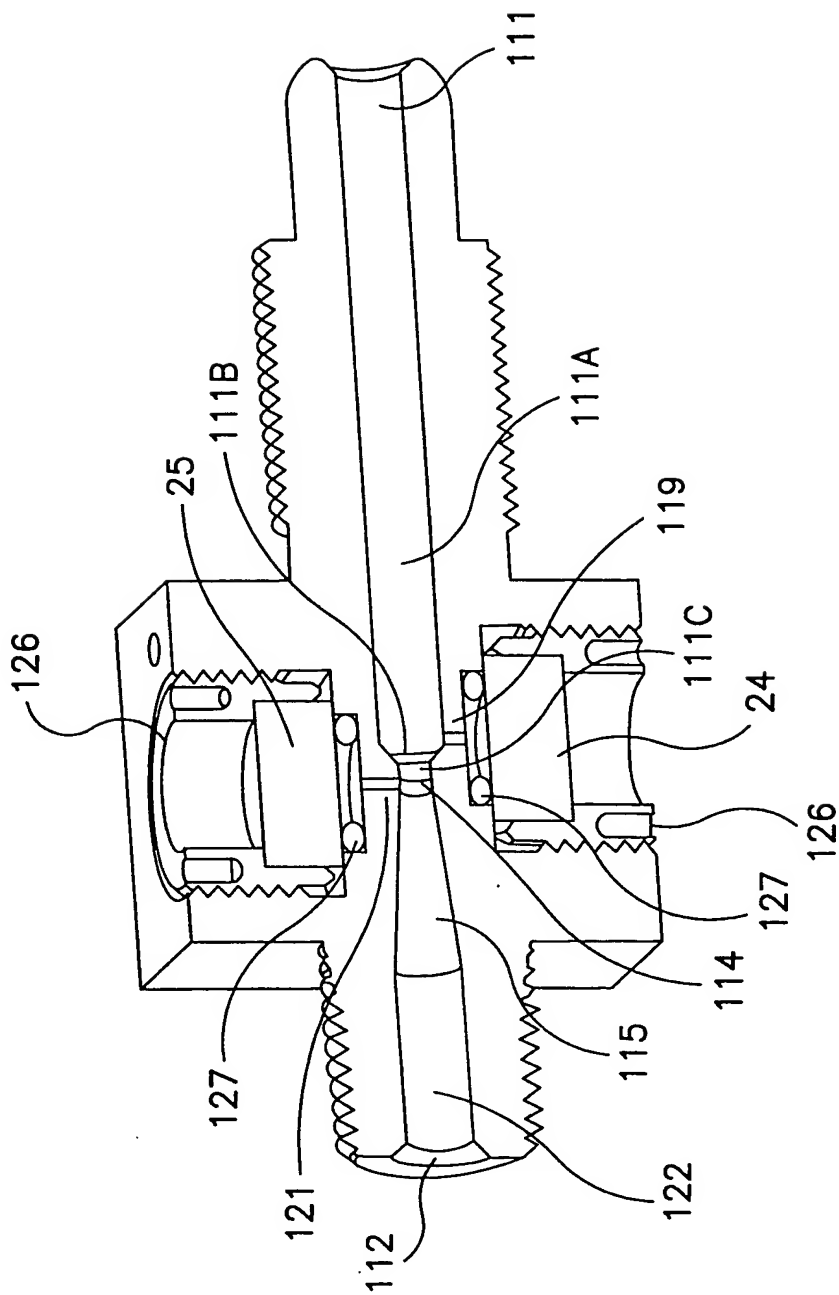Signature of person mailing paper or fee

FIG. I

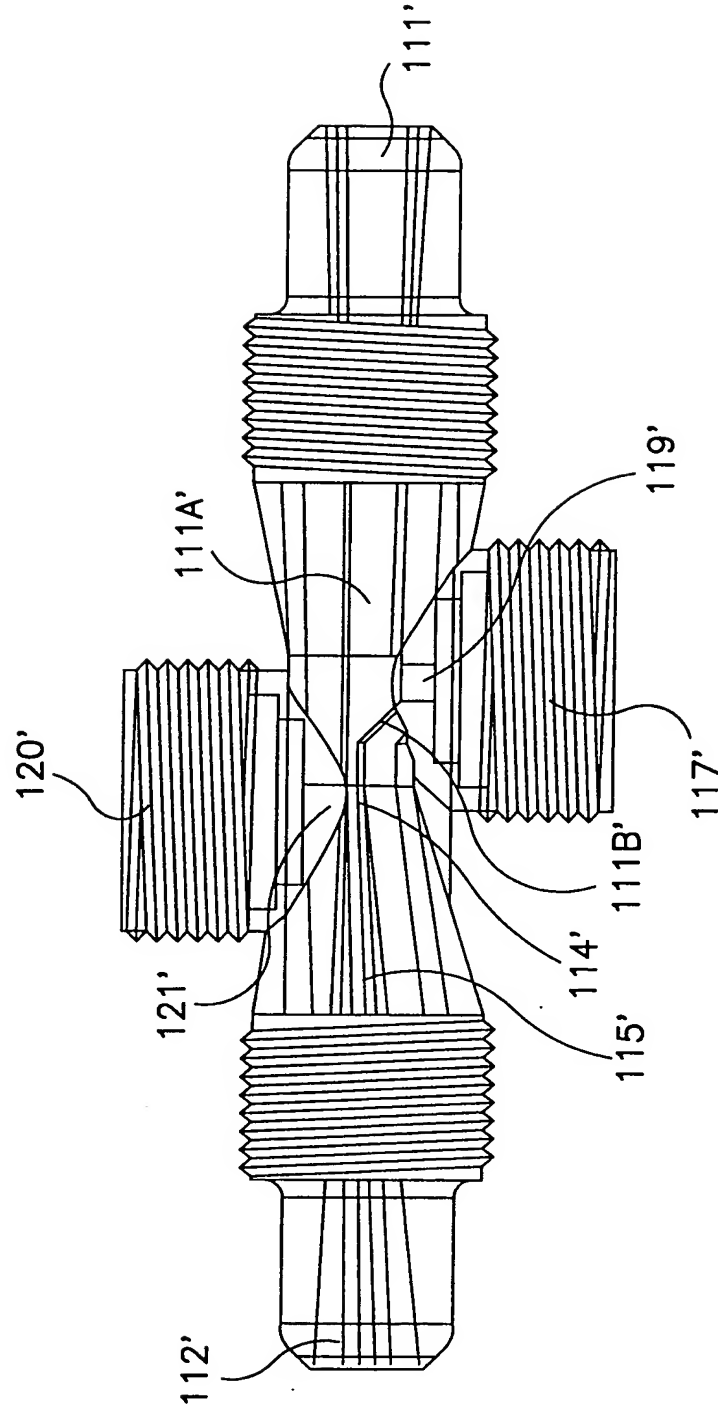Concentric venturi

111

111B

111A

121

119

120

117

111C

114

115

112

FIG. 2

Concentric venturi

FIG. 3

Eccentric flat channel venturi

FIG. 4

307

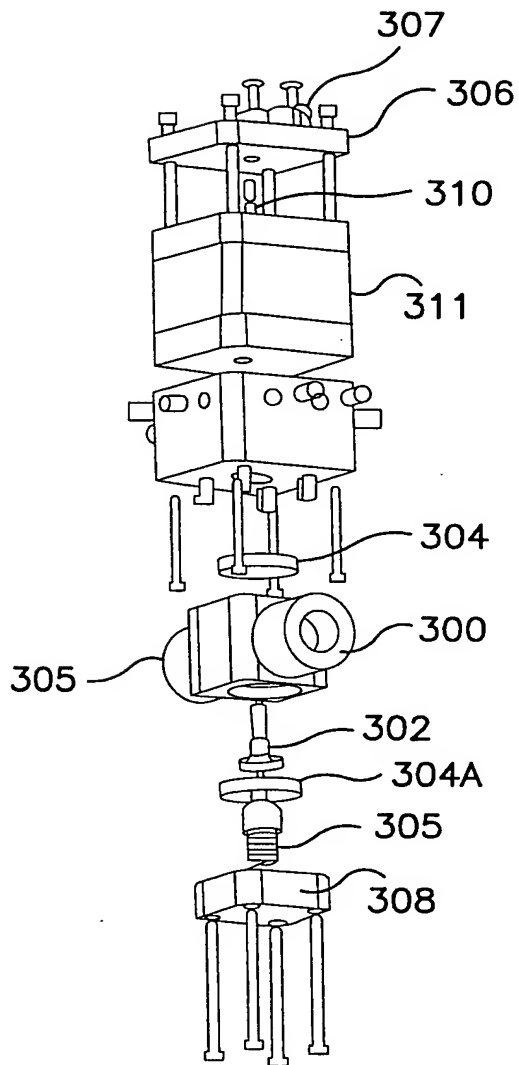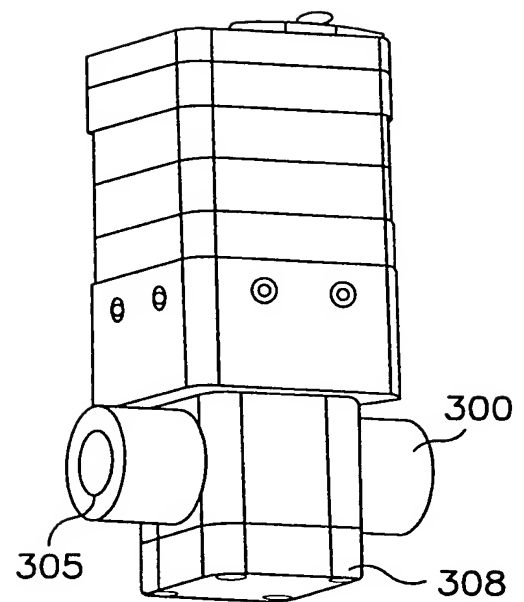306

310

311

304

300

305

302

304A

305

308

FIG. 5

300

305

308

FIG. 6

A   302A   302

FIG. 7

45.0°

0.043

7.5°   0.003

16°

FIG. 7A

303

302'

FIG. 8

304

302"

FIG. 9

302'''

FIG. 10

10/521697
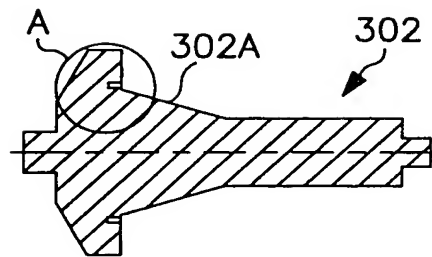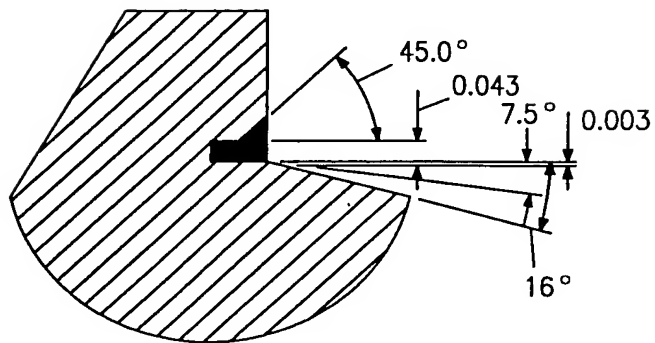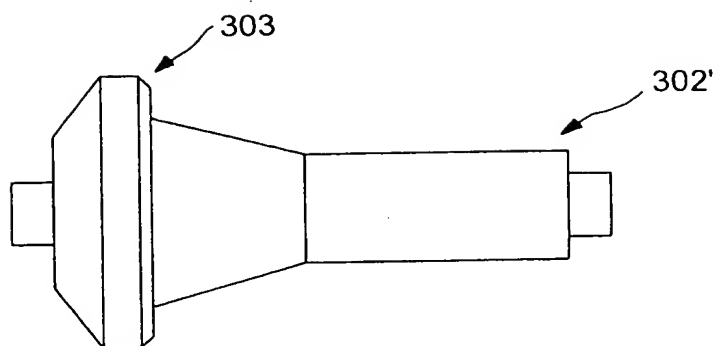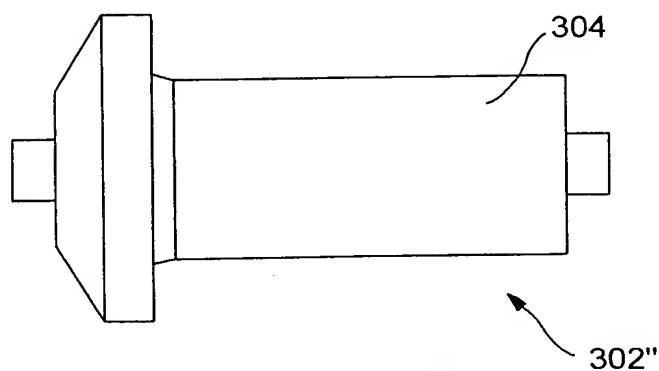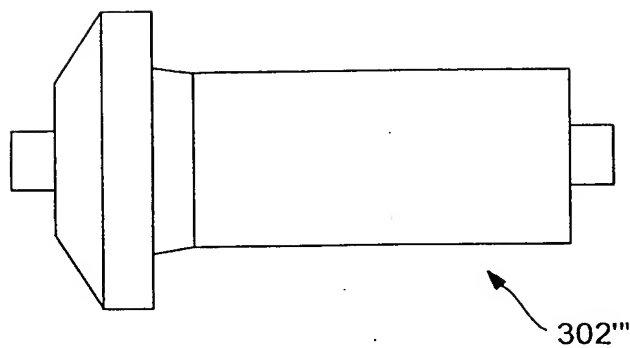
Heat Exchanger (5265-65-3): Shell ID = 2.25 in, Length = 18 in
Shell (HOT) Flow = 1460 ml/min; 70+/-0.1 C
300ml total dispense dispense volume @ 67.4+/-0.9C in 15 sec; off cycle 45 seconds
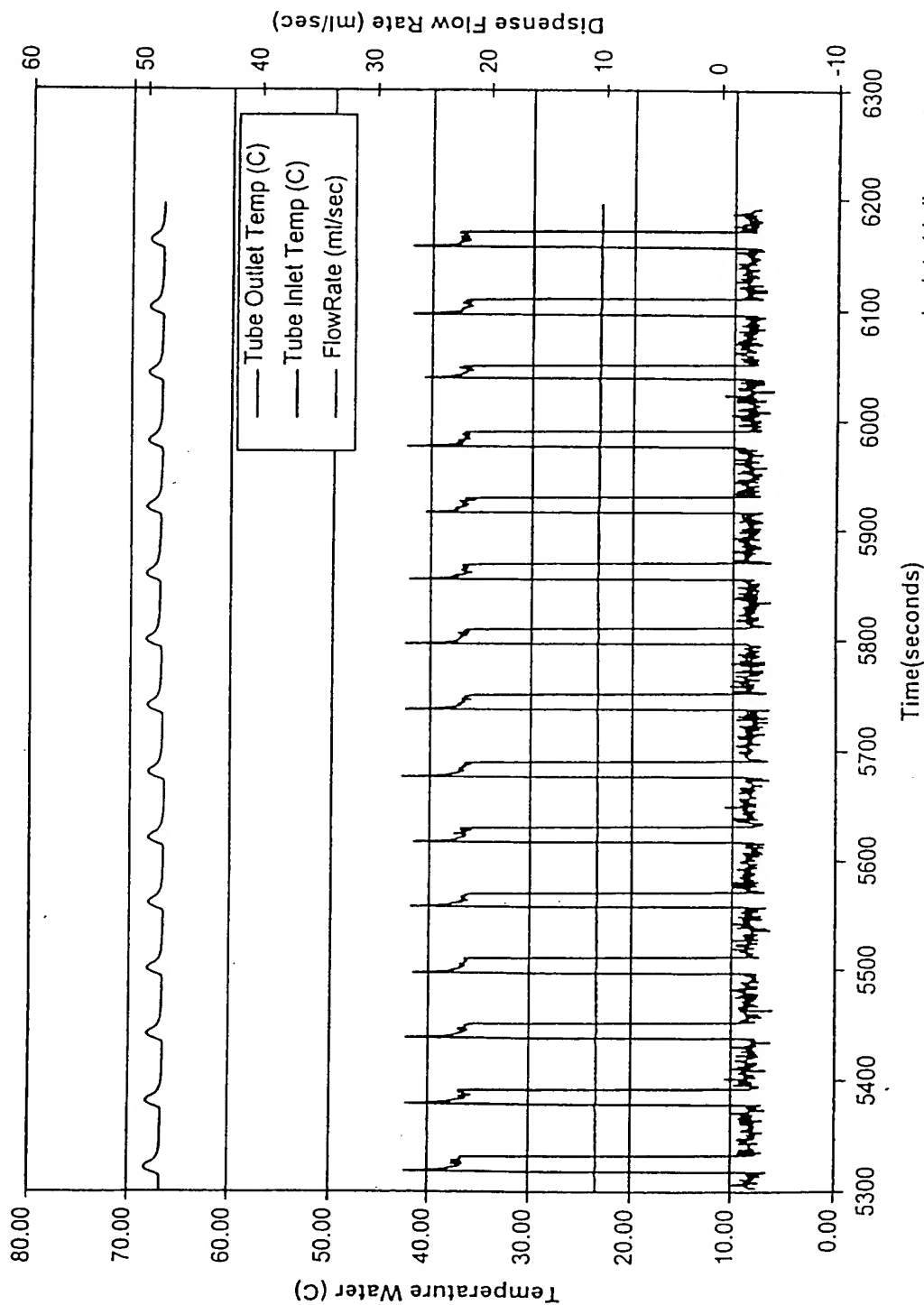
hedata44-dispense 300 ml min 18 inch unit.xls

FIG. II

Heat Exchanger: Shell ID = 2.25 in, Length = 8 in
Shell Flow = 500 ml/min @ 27.1 C

Tube Flow = 1150 ml/min; Cycle 5 seconds on, 10 seconds off Dispense Volume = 100ml
Tube Inlet Temperature = 23.4 C

hedata47-developer dispense.xls 500 flow 15 cycle

FIG. 12

FIG. 13

Flute #1
0711flute1flow.xls

——	P1 Inlet (PSI)
——	P2 Outlet (PSI)
——	FlowSetPoint(ml/S)
——	FlowRate(ml/S)

Flow Rate (ml/sec)

Time (sec)

FIG. I4

FLUTE 6UVT2 (1/4") VOLUMETRIC FLOW RATE vs PRESSURE DROP

$y=6.4005x^{0.5438}$
$R^2=0.995$

$y=5.7903x^{0.5429}$
$R^2=0.998$

$y=5.7994x^{0.5342}$
$R^2=0.9982$

◇   IPA Vd Flow
☐   H2O Vd Flow
△   IPA/GLY Vd Flow
——Power (IPA Vd Flow)
——Power (H2O Vd Flow)
——Power (IPA/GLY Vd Flow)

FLOW RATE (ml/sec)

PRESSURE DROP (psid)

FIG. 15

FLUTE 6UVT2 (1/4") VOLUMETRIC FLOW RATE vs $2_D P/_r$

$$Q_{IPA} = 3.8405(2_D P/_r)^{0.5438}$$
$$R^2 = 0.995$$

$$Q_{H2O} = 4.0001(2_D P/_r)^{0.5342}$$
$$R^2 = 0.9982$$

$$Q_{IPA/GLY} = 3.8405(2_D P/_r)^{0.5429}$$
$$R^2 = 0.998$$

◇ IPA Vd Flow
□ H2O Vd Flow
△ IPA/GLY Vd Flow
—— Power (IPA Vd Flow)
—— Power (H2O Vd Flow)
—— Power (IPA/GLY Vd Flow)

FLOW RATE (ml/sec)

$2_D P/_r$

FIG. 16

CALIBRATION CURVE COEFFICIENT C' vs KINEMATIC VISCOSITY FOR FLUTE 6UVT2
(1/4")

$$C'=4.0803-0.0871n$$
$$R^2=0.9992$$

FIG. 17

FLUTE 6UVT2 (1/4") FLOWMETER CONSTANT 'K'

$K=C'(2/_r)^{.5403}=)4.0803-.0871_n)(2/_r)^{.5403}$

$K_{IPA}=5E-06t^3-0.0005t^2+0.0305t+5.8762$
$R^2=1$

$K_{H20}=-3E-09t^4+1E-06t^3+1E-04t^2+0.0066t+5.7098$
$R^2=1$

□ KH20
◇ KIPA
— Poly. (KH20)
— Poly. (KIPA)

TEMPERATURE °C

FIG. 18

VOLUMETRIC FLOW RATE vs PRESSURE DROP FOR FLUTE 6UVT2 (1/4")

FIG. 19

Read temperature — 2000

Temp vs Sensor
Output (mV)
Algorithm/Table → Calculate
Temp 'Offset'
In mV — 2004
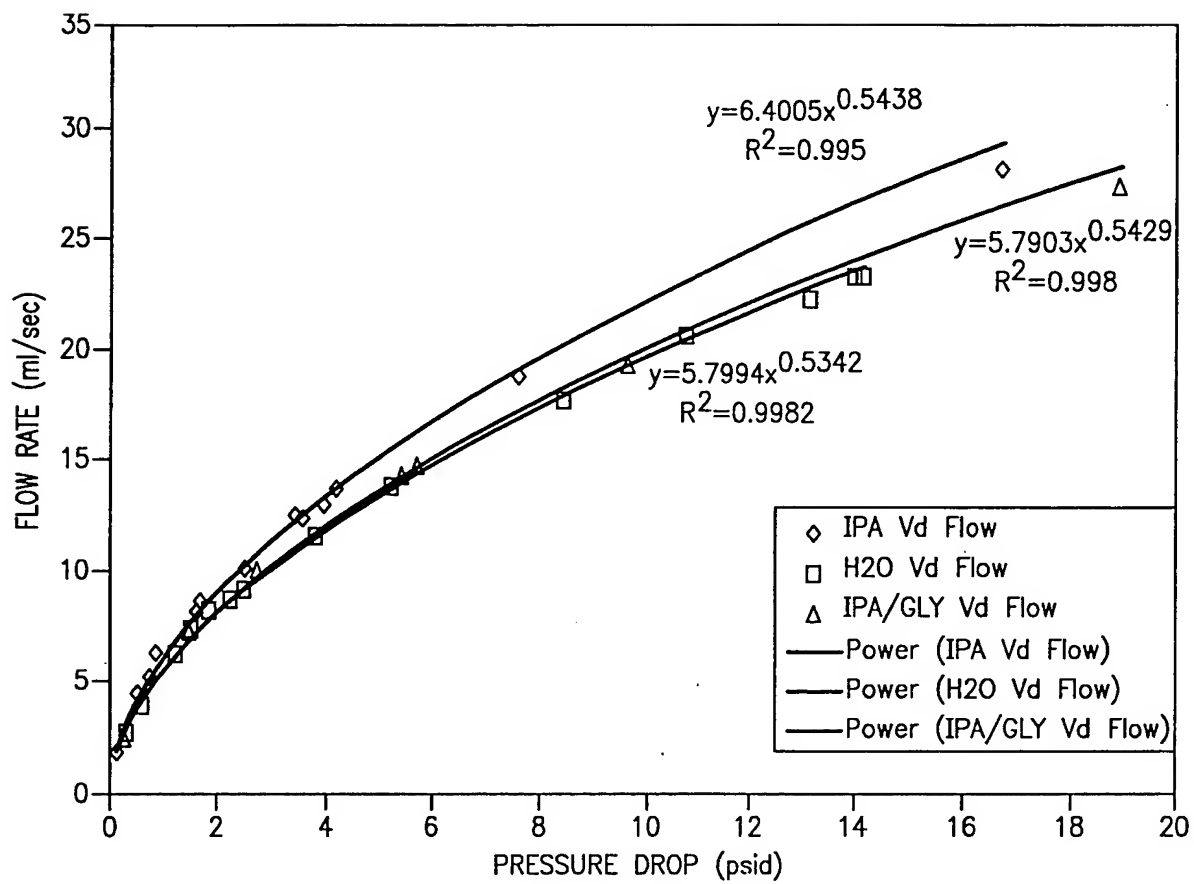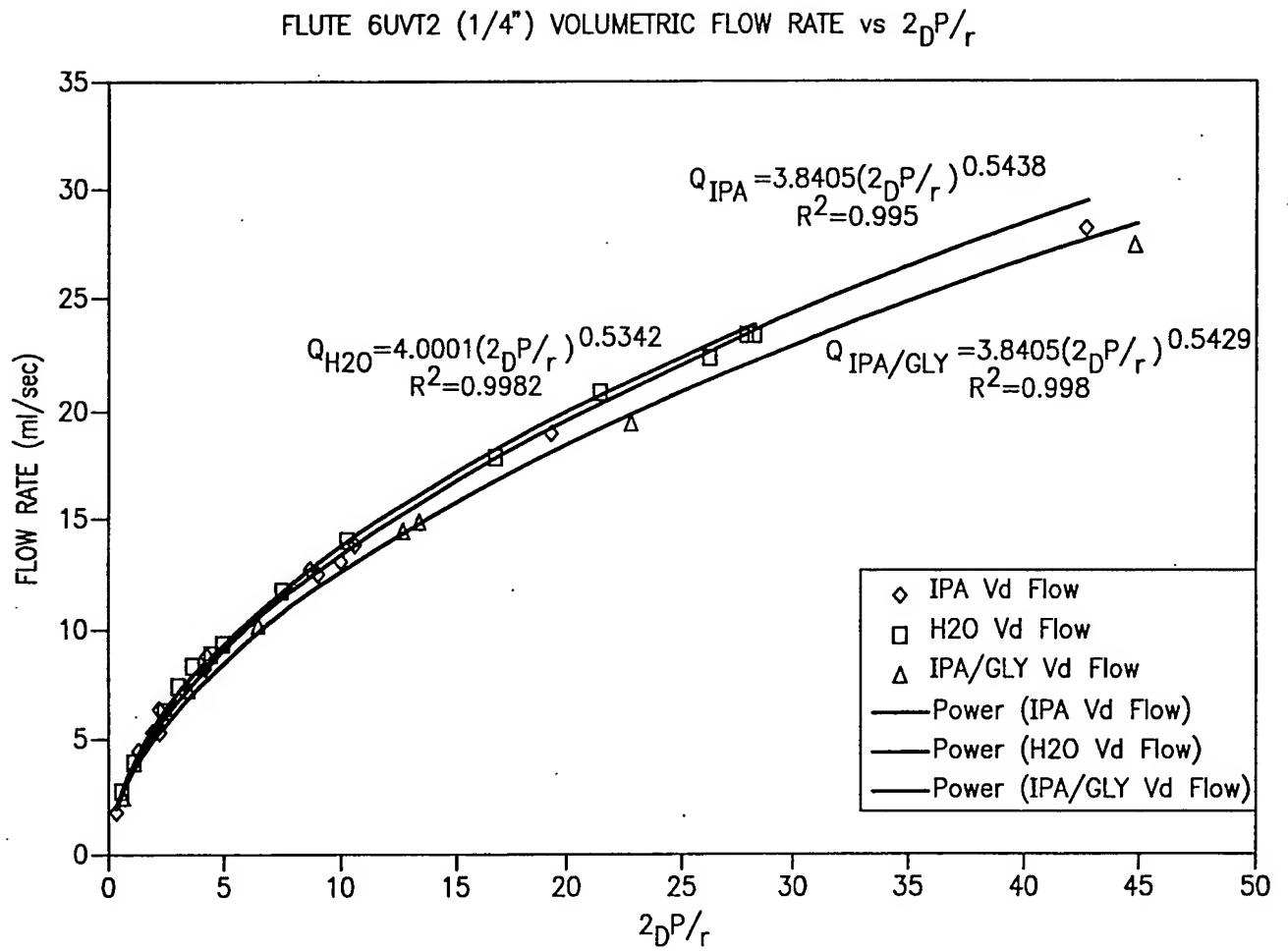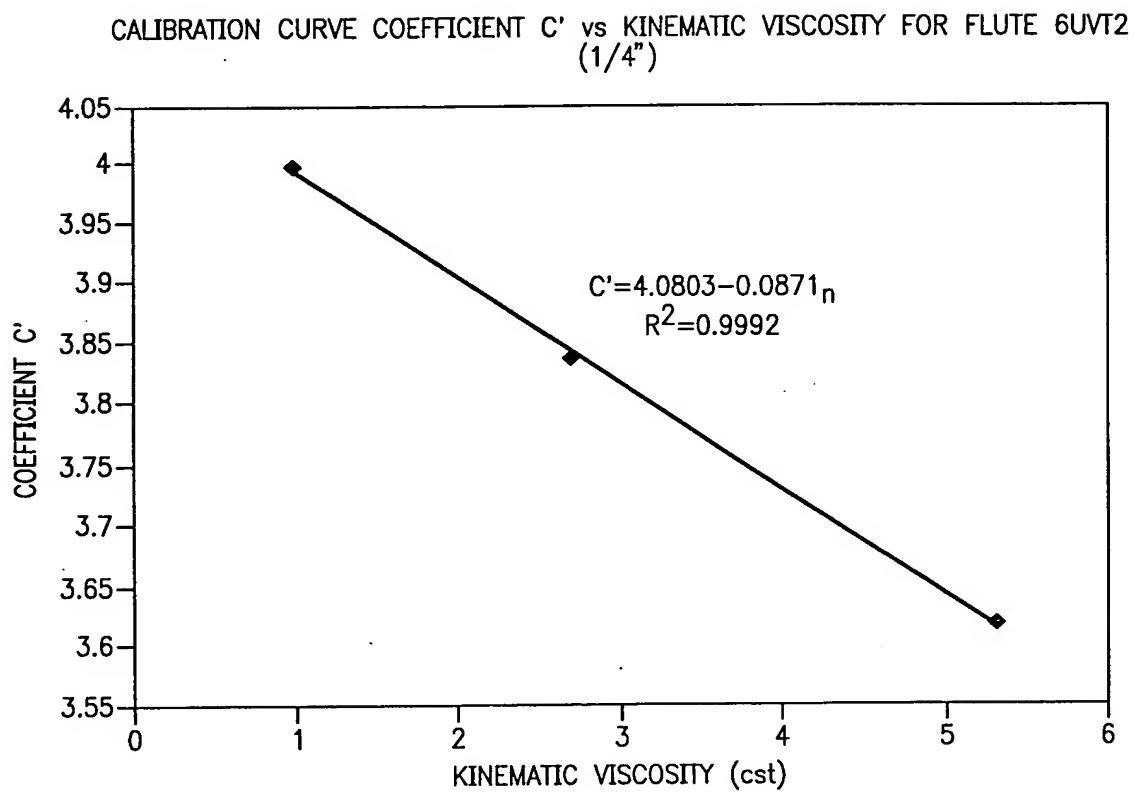
2006 → Read Pressure
Sensor 1 → Correct
Pressure
Signal
Temperature — 2008 ← Read Pressure
Sensor 2 ← 2006

Algorithm for
Sensor 1
P1=f(mV) linear → Calculate P1;
P2 and Delta P
(P1-P2) — 2010 ← Algorithm for
Sensor 2
P1=f(mV) linear

Algorithm/Table
Visc=f(temp) →
Calculate
Coefficient 'K'
K=f(v,p,C',n) — 2012 ← Coefficient 'C'',
Exponent 'n' from Flow
Device Calibration
Algorithm/Table
Density=f(temp) →

Calculate Flow
Rate 'Q'
Q=f(K,ΔP,n) — 2014 ← Exponent 'n' from
Flow Device
Calibration

Adjust
Control Valve ← Calculate Flow
Rate
Correction — 2016 ← Flow Rate
Set Point

FIG. 20

Temperature Sensor Input 2112	**Micro-controller** 128KBytes Flash 6KBytes SRAM 2KBytes EEPROM Serial Communications Interface(2) CAN Channels(2) A10D Converter(16) 12C Interface Serial Peripheral Interface PWM Channels(4) General Purpose Timers(2) 2100	**Auxiliary Analog Output**
Auxiliary Analog Input		**Linear Actuator Interface**
Digital Inputs (4) Optically Isolated		**Sleeper Motor Driver** 2113
RS232 Diagnostic Port		**Pulse Width Modulator**
RS485 Remote Control Port		**Digital Outputs (4) Open Collector**
CAN Port #1 Device Net		**Flash** 2108 2104
CAN Port #2		

Interface Connector 2111

2114 2102 2110

Pressure Sensor Inputs	**Digital Signal Processor**	**128Mbyte Flash**

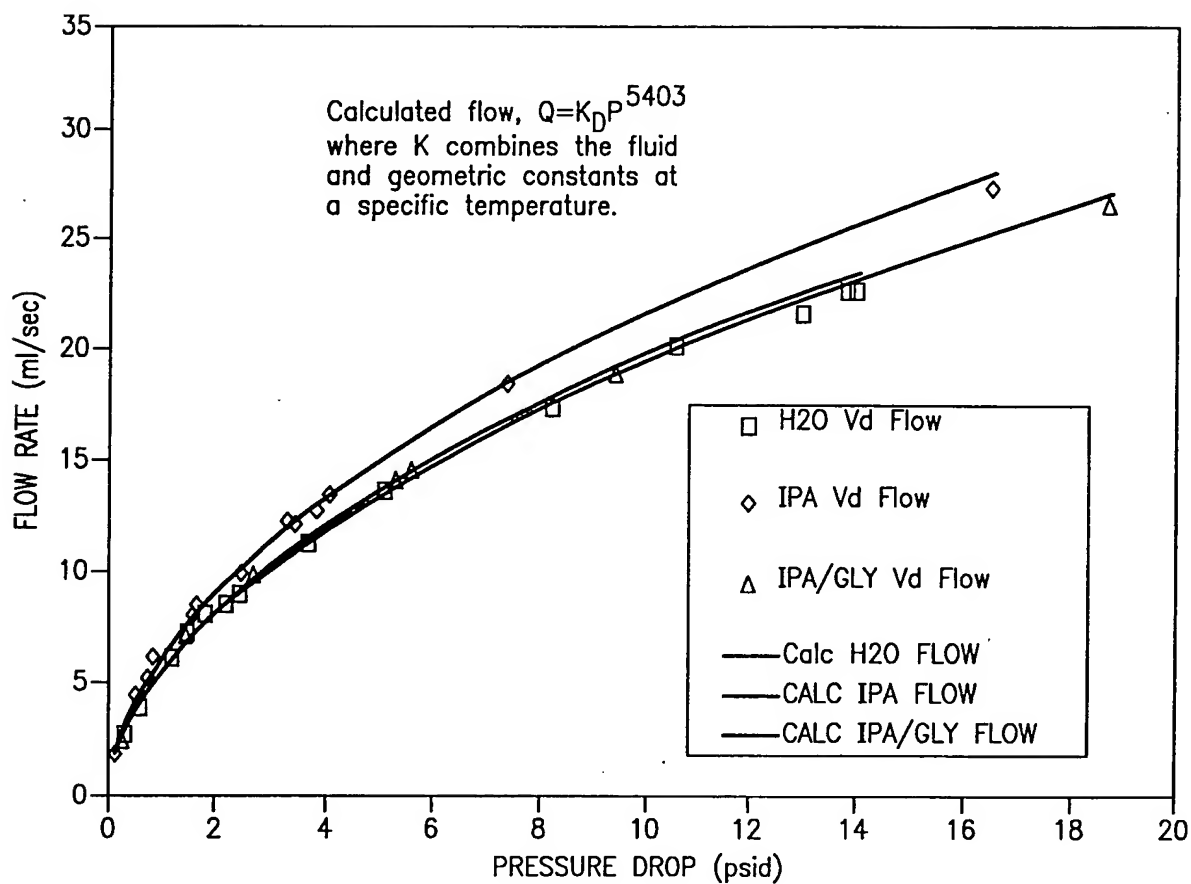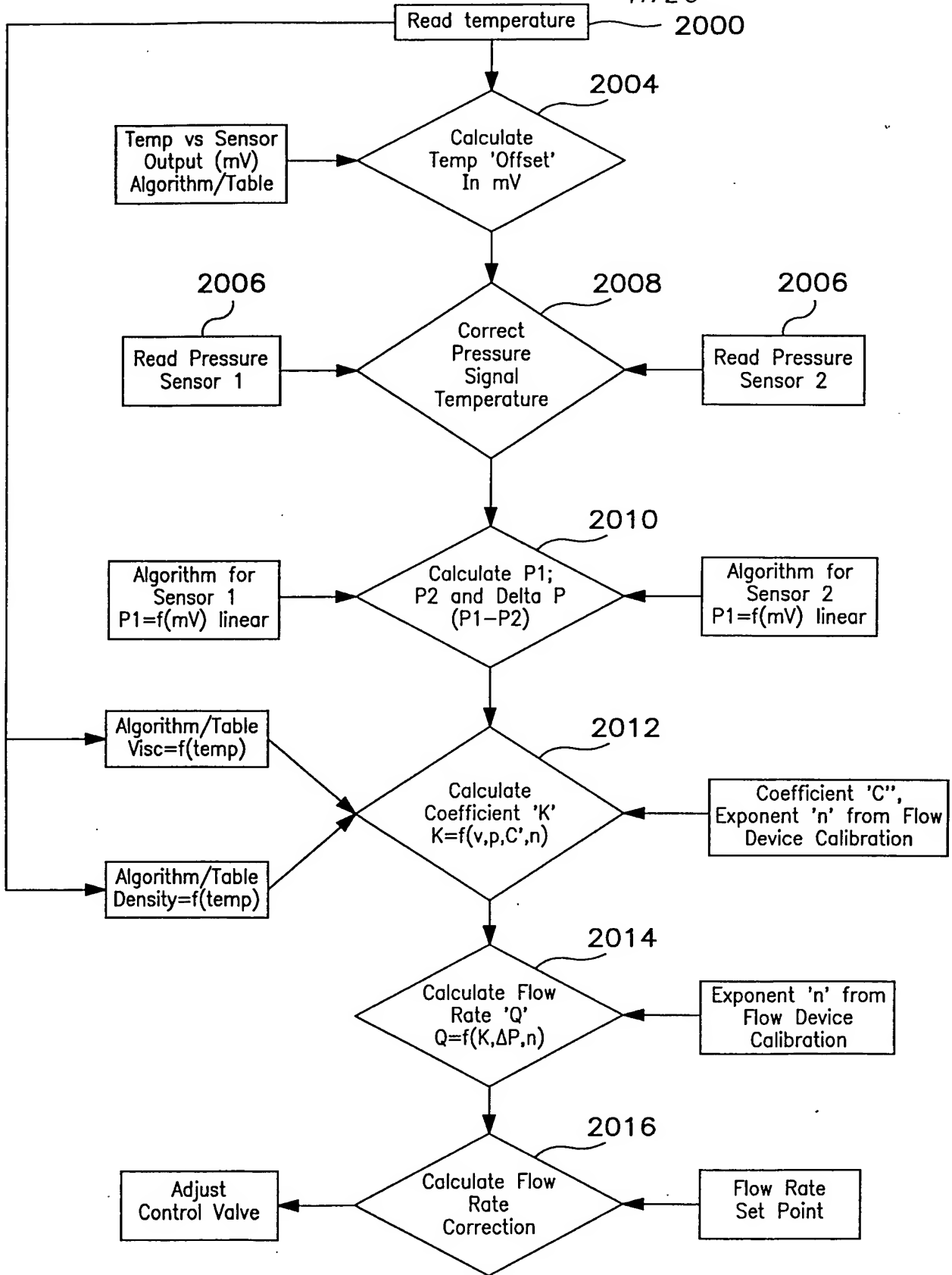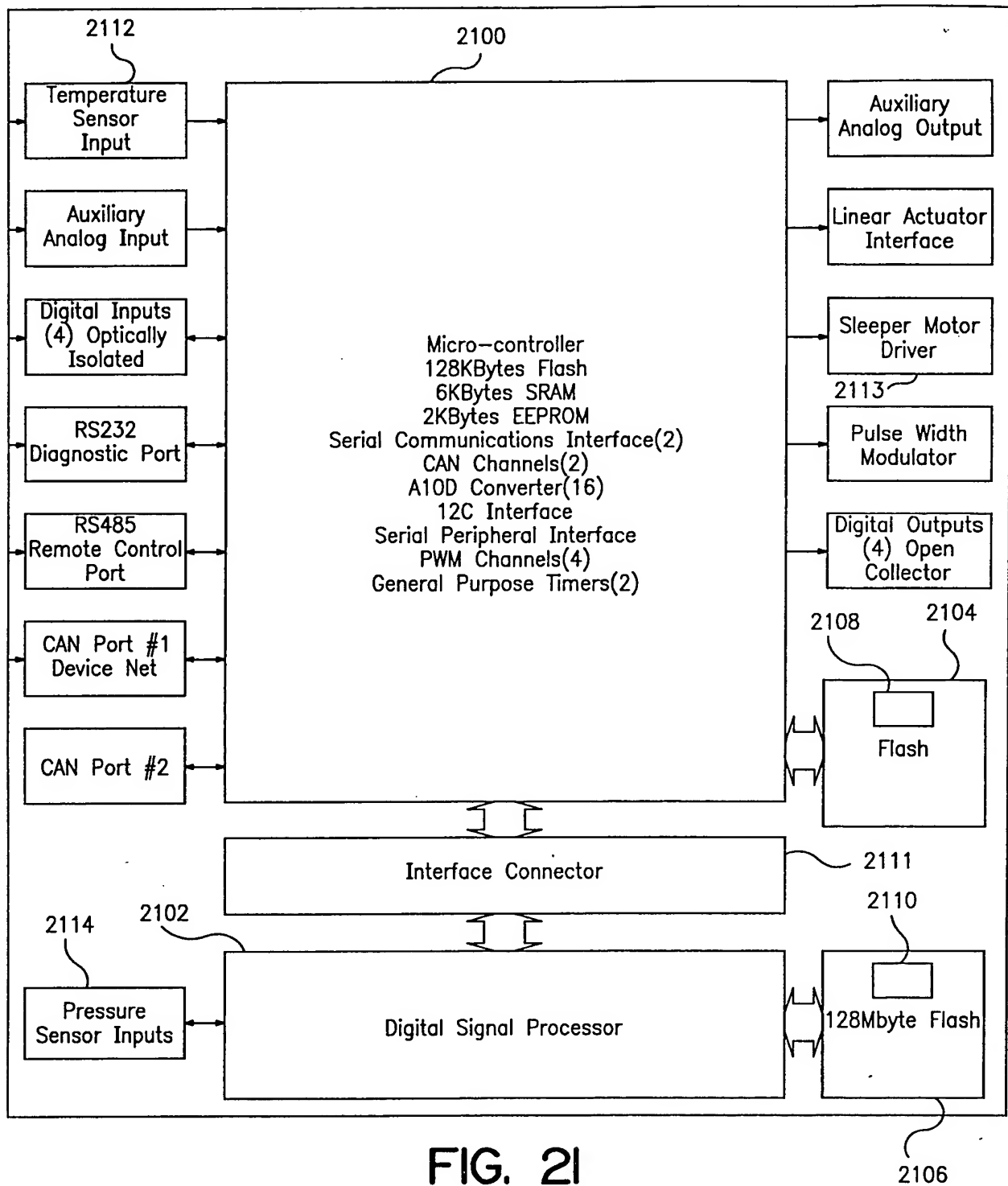## FIG. 21

2106

As long as the fluid speed is sufficiently subsonic (V < mach 0.3), the incompressible Bernoulli's equation describes the flow. Applying this equation to a streamline traveling down the axis of the horizontal tube gives,

$$P_a - P_b = \Delta p = \frac{1}{2}\rho V_b^2 - \frac{1}{2}\rho V_a^2$$

From continuity, the throat velocity V_b can be substituted out of the above equation to give,

$$\Delta p = \frac{1}{2}\rho V_a^2 \left[\left(\frac{A_a}{A_b}\right)^2 - 1\right]$$

Solving for the upstream velocity V_a and multiplying by the cross-sectional area A_a gives the volumetric flowrate Q,

$$Q = \sqrt{\frac{2\Delta p}{\rho}} \frac{A_a}{\sqrt{\left(\frac{A_a}{A_b}\right)^2 - 1}}$$

Ideal, inviscid fluids would obey the above equation. The small amounts of energy converted into heat within viscous boundary layers tend to lower the actual velocity of real fluids somewhat. A discharge coefficient C is typically introduced to account for the viscosity of fluids,

$$Q = C\sqrt{\frac{2\Delta p}{\rho}} \frac{A_a}{\sqrt{\left(\frac{A_a}{A_b}\right)^2 - 1}}$$
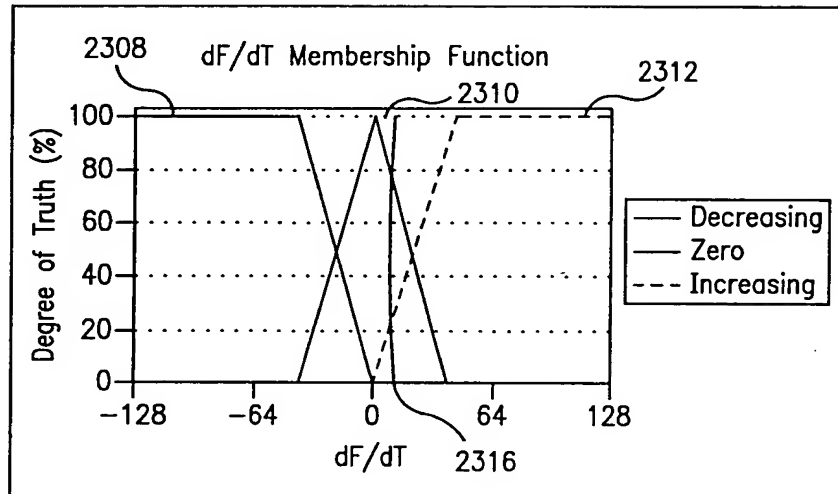
FIG. 22

10/521697
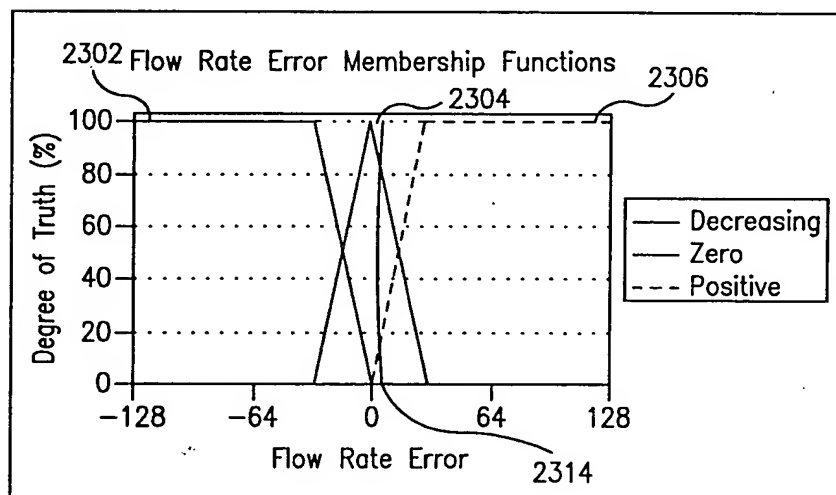

FIG. 23B

FIG. 23A